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13. ABSTRACT (Maximum 200 words)

A computer science laboratory was established at UT Permian Basin, including three major components. A Windows administration environment in which hardware/Microsoft software systems are built, a Unix administration environment in which Unix (Linux) based systems are built, and a research and development environment for both Windows and Unix have been established. The R & D environment consists of 18 Windows-based workstations, two Windows NT servers, six Sun workstations and two Sun servers. This student-oriented laboratory is now in use in several regular undergraduate classes and by approximately 25 students doing senior research projects.

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Final Technical Report

Computer Science Laboratory
at
The University of Texas of the Permian Basin

February 1, 2001

Computer Science Laboratory
at
The University of Texas of the Permian Basin

Introduction

The original grant proposal asked for funding to establish a computer science laboratory at UT Permian Basin. The lab was to be separate from the University's central computing labs and used for instruction and research by undergraduate students and the faculty. In the proposal, the purposes of the lab were described as follows:

1. *The main purpose of the CSL is to provide computer aided instruction (CAI) environment for computer science major students. The philosophy of the computer science program is to provide cutting-edge knowledge and skills for its students, while providing them with a strong liberal arts-based general education at the same time. Computer science students at UTPB are individuals who will work in the society and industry of the 21st century. The computer science faculty wishes to provide the practical knowledge and skills of information technology through a cutting edge computing facility, in addition to the advanced computer science theories presented in the classroom. This will enable the UTPB computer science graduate to be immediately productive as an information technology specialist, keeping re-education by companies to an absolute minimum.*

2. *The second purpose of the CSL is to provide computer based training (CBT) programs for computer science students. In addition to their course hours, computer science students will be able to use regularly a modern industry-oriented computing facility. Since the information technology industry prefers certificates in commercial information systems in addition to computer science degree, it will be to the advantage of our computer science students to take various information technology related certification examinations while working on their upper-level courses.*

3. *In addition to providing CAI and CBT for computer science students, the CSL can also provide a research and development environment for the UTPB. The University constantly needs cutting edge information technology to develop and support its general information systems. The CSL can provide strong research and development computing environment for the University through the collaboration of computer science faculty and students, IRD staff, REACH (Regional Electronic Academic Communications Highway) Program Center, and other departments. The REACH Center provides technological support for distance courses and in particular for Web-based courses. The Center currently utilizes the talents of several computer science students in support of Web course development. As the number of faculty who want to develop Web-based courses grows, so will the demand for support, both in the form of student expertise and in the level of sophistication of hardware and software systems. The potential for synergy between the REACH Center and the CSL is great enough that the REACH Center will partially support the development of the lab.*

4. *Finally, the CSL can be used for providing high-end computer based training programs for the UTPB students, faculty, and staff and for the greater Permian Basin community. The CSL facility could be used for computer training programs presented by computer science faculty and advanced computer science students. With the certification training developed by computer science faculty and students, the CSL could support continuing education activities at the UTPB Center for Energy and Economic Diversification that would be available for the Permian Basin community.*

Again, from the original proposal, the lab configuration is described this way:

Since one of main goals in the UTPB CS program is to have computer science students prepare for future job demands, the CSL computing environment must be directly related to providing computer science students with practical knowledge and professional skills. Two operating system (OS) environments will therefore be supported: a Windows OS environment and a UNIX OS environment. Computer science students must expect to play a variety of different roles in a diverse and constantly changing information technology industry after graduation. Thus, each operating system environment will have the same three components:

Windows environment (Windows NT Server, Windows NT Client, Windows 95, Windows 98)
- *Administration*
- *Research and Development*
- *Instruction*

UNIX environment (Sun Solaris)
- *Administration*
- *Research and Development*
- *Instruction*

The administration environment provides students with the opportunity to study hardware and software administration and maintenance. Since the hardware and software components will routinely be installed and uninstalled, normal system usage will be interrupted. Here students will study the roles of system and database administrators, webmasters, and even technicians, by controlling all hardware and software components. On the other hand, in the research and development environment, students must be able to use software and hardware for their projects without having to deal with frequent interruption. Both the administration and research and development facilities will typically be used by individual students or small groups of students working in direct association with faculty. The instruction environment will provide for larger groups in upper level computer science courses. The computer science curriculum and the CSL computing environment must be highly integrated. Since the computer science students will play different roles in the diverse and constantly changing information technology industry after graduation, a variety of industry oriented and forward looking computing environments are required. Table 2 shows the broad relationships among expected future careers after graduation, current UTPB computer science courses, and the computing environment required for the courses.

The lab was to be developed in several phases, described in the proposal as follows:

> *There are five phases in the CSL development plan. The short-term plan is Phase I, Phases II and III make up the mid-term plan, and Phases IV and V comprise the long-term plan. The goals of each phase of the plan are as follows:*
>
> *Phase I*
> - *Windows administration environment fully established*
> - *UNIX administration environment partially established*
>
> *Phase II*
> - *Windows research and development environment fully established*
> - *Windows instruction environment partially established*
>
> *Phase III*
> - *UNIX administration and research and development environments fully established*
>
> *Phase IV*
> - *Windows instruction environment fully established*
>
> *Phase V*
> - *UNIX instruction environment fully established*

Overview of acquisitions

The University provided funding for Phase I, in which a Windows administration environment was created. This environment includes a Gateway ALR7300 server, a total of 14 workstations built by the students from components, and Windows NT server and various Windows client software, installed by the students. Some of the workstations were also set up with Linux, as the start of the UNIX administration environment.

Funding was provided by the grant for the implementation of Phases II and III. These phases together establish the UNIX administration environment and begin the development of both Windows and UNIX instruction environments. The UNIX administration and instruction environments are supported by two Sun Ultra 10S server systems and six Sun Ultra 10 workstations, running Solaris server or client software. Oracle licensing was also obtained for the Suns. The Windows environment was enhanced by the addition of a second server, a Gateway ALR7210, dual processor model, and six Gateway 4200 workstations. The Windows instruction environment now consists of 14 Windows workstations, each equipped with a copy of the Object Domain UML software. These stations are in a lab, not a true classroom, configuration, but are separate from the administration systems which are located in another lab space.

In addition to the servers and workstations, various communications equipment, twelve monitors, and two laser printers have also been put in the lab. A Cisco 2514 router serves as the connection between the lab network (a single class C domain) and the University's LAN. A data switch and several hubs, along with

cabling have also been provided. Extra monitors were acquired to replace the original surplus monitors used on the workstations built in Phase I and subsequently placed in the instruction lab and the old monitors on two older SPARC stations donated to the lab by Texaco.. The printers are an HP LaserJet 4050N and an HP LaserJet 4500N (color), both of which are on the network.

Details of the hardware and software, along with costs, can be found in Appendix A.

Overview of usage

Phase I

Students and faculty have been working on lab activities since spring 1999 when the University provided initial funding for a server and the components needed to build four Windows based systems. Student project teams were each assigned the task of building a client/server pair (Windows NT) from components. They were to select components, assuming they would have surplus cases, monitors, and keyboards supplied by the University's Information Resources Division. The project teams were to work within a $1200 limit for the components needed to build a server and a client. The University provided the software necessary for the set-up. The clients were to be Windows NT with the server also running Windows NT and supporting the BackOffice suite of applications.

During fall 1999, additional funds were provided to purchase the components for six more systems and in spring 2000, eight more were added. In the spring, some of the teams worked with Linux rather than Windows software. By the end of spring 2000, approximately 50 students had gone through the process of building hardware systems and installing the software necessary to operate them.

Phases II and III

During the fall 1999 semester, faculty, together with some senior research students, identified the specific hardware and software requirements for these phases and began the process of ordering the various systems. As the equipment was ordered and received, teams of students prepared an inventory of equipment (including software), designed the layout for the new space to be used for the lab, and described naming conventions for equipment. The University completely remodeled approximately 2000 square feet of space to accommodate the new lab and provided tables, chairs, cabinetry, and other furnishings for the new space.

The Sun stations have been set up and Oracle software placed on them. Most of the hardware and software system set-up was carried out by student project teams working with faculty members. The Windows stations in the instructional

lab are set up and were used during the fall 2000 semester for the software engineering course, in which students used the Object Domain modeling software. Several student teams also worked on a variety of projects in the lab. Specific examples of work done by student project teams during the fall 2000 semester include:

Scheduling project:

- The students in the software engineering course (COSC 4460) completed a class project to help the deans and other administrators with course scheduling problems. The application is Web-based, running in a Windows NT environment with a database component to keep the list of classes in the schedule.
- The Configuration Team set up a configuration management system for the class project for submission of documents to a controlled web site by all groups working on the project. They created the directories on the server, created the web site, and created forms for submission of documents. They would not have had the required access to do this work through the main computing facilities on campus.
- The Architecture Team set up the development and target environments, doing everything from installing the operating systems and setting up the networks to setting up the Web sites with database access. Again, they would not have had the required access without the research labs. Some of these students have already found networking and Web design jobs partially because of this experience.

Distributed Systems Projects:

- The students in the distributed systems course (COSC 4475) completed several projects which required special access to the computing facilities. One of these projects involved writing an application to allow several people to play a computer game together, with each person logged on to a different PC. The application took advantage of sockets and threads of execution, which could be started by the application on different machines and executed concurrently. The class also had a chance to work with a true multiprocessing system, the new Gateway server acquired for the lab. All the students in distributed systems got hands-on experience with the problems and solutions associated with concurrent execution instead of just reading about these problems in a book.

For more information on some of this work, please see these Web-sites:

http://pegasus.utpb.edu/teaching	(work prior to fall 2000)
http://pegasus.utpb.edu/cosc4495	(research fall 2000)
http://pegasus.utpb.edu/cs4460	(software engineering fall 2000)

During the spring 2001 semester, the introductory information systems (COSC 3315), data structures (COSC 3420), and the operating systems (COSC 4330) classes will utilize lab facilities. Approximately 30 research students (COSC 4495) are expected to work on individual or team projects in the lab during the semester also. Specifically planned activities include:

- Information systems students will be introduced to the Object Domain UML-based modeling software newly installed in the lab.
- Operating systems students will install, modify, and otherwise work with the Minix and Linux operating systems, doing work never before possible using the University's central computing facilities.
- Data structures students will experiment with more elaborate programs which test the limits of the computer system on which they run, without putting at risk the University's main computing facilities.

Finally, it should be noted that the lab has begun to serve as a social gathering point for the computer science community of students and faculty. Since UT Permian Basin is a commuter school, the students do not have the usual social contact outside the classroom they might have on a residential campus. Having a place of their own has done a great deal to increase the spirit of community among the computer science students.

The future

It is likely that funding will be sought within the next year in order that the completion of Phases IV and V can be undertaken. It now appears that Phase IV will be modified to include a communications component in the lab. That is, we would set up several routers, distribution frames, and subnetworks within the lab so that students can gain hands-on experience with data communications equipment without threatening the security of the University's LAN. The final step, Phase V, will be the actual creation of a classroom equipped with computer systems accessible to each student in a class.

Appendix A
Summary of Expenditures

UTPB matching funds:		
Spring 1999	10274	
Computer components (4 systems)		
Server (Gateway ALR 7300)		
Software (BackOffice, Visual Studio Enterprise)		
Fall 1999	7198	
Computer components (6 systems)		
Software (BackOffice, Linux)		
Spring 2000	8263	
Computer components (8 systems)		
Software (BackOffice, Linux)		
Fiber to copper converter		
Other	15462	
Furnishings (tables, chairs, cabinets)		
Total		**41197**
AFOSR grant funds:		
Windows environment	22974	
Workstations (Gateway 4200-800, 6)		
Server (Gateway ALR7210)		
Software (Object Domain)		
Unix environment:	32831	
Workstations (Sun Ultra10, 6)		
Server (Sun Enterprise Ultra10S, 2)		
Extra 19" monitor (2)		
Software (Oracle)		
Miscellaneous:	20489	
Printers (HP4050N, HP4500N)		
Monitors (Sony, 10)		
Switch		
Router (Cisco 2514)		
Cabling/supplies		
Total		**76294**

Summary	Proposed	Actual
AFOSR	82970	76294
UTPB	27118	41197
Total	110088	117491

Appendix B
Detail of Expenditures

Matching UTPB funds, Spring 1999			10274	
Computer components (4 systems)		2233		
Server (Gateway ALR 7300)		5699		
Software (BackOffice, Visual Studio Enterprise)		2342		
Matching UTPB funds, Fall 1999			7198	
Computer components (6 systems)		3511		
BackOffice software (4 by 5 seats)		3477		
Linux (3 licenses)		210		
Matching UTPB funds, Spring 2000			8263	
Computer components (8 systems)		4926		
BackOffice software (3 by 5 seats)		2865		
Linux (4 licenses)		292		
Fiber to copper convertor		180		
Matching UTPB funds, other			15462	
Furnishings (tables, chairs, storage cabinets)		15462		
Total, UTPB Matching				**41197**
Grant expenditures, Windows environment				
Server, Gateway ALR7210			6442	
Workstation, Gateway 4200 - 800	6	2502	15012	
Software - Object Domain			1520	
Grant expenditures, UNIX environment				
Server, Sun Enterprise Ultra10S	2	5342	10684	
Workstation, Sun Ultra 10	6	3032	18191	
Extra 19" monitor	2	480	960	
Software - Oracle			2996	
Grant expenditures, miscellaneous				
Laser printers			4810	
HP LaserJet 4050N		1549		
HP Color LaserJet 4500N		3261		
Monitors (19" Sony)	10	580	5800	
Switch			4604	
Router -- Cisco 2514			2487	
Cabling/Supplies			2788	
Total, Phases II and III				**76294**

Summary of expenditures	Proposed	Actual
AFOSR Grant funds	82970	76294
UTPB matching funds	27118	41197
Total	110088	117491